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FILTER ASSEMBLY WITH DRAIN OUTLET

The present invention relates to a fluid filter assembly for filtering a fluid using a filter element mounted on a support in a housing between a fluid inlet and fluid out formed in the housing. In particular, the present invention relates to the provision of a drain outlet in the housing.

The present invention may be applied to an oil filter assembly, for example of the type used in a combustion engine. In such an assembly, the filter element is typically in the form of a corrugated sheet formed into an annulus and mounted on a support including annular end walls extending around respect ends of the filter element.

It is known to provide such a filter assembly with a drain outlet which has the purpose of draining oil from the housing when the filter element is replaced. Typically, the drain outlet will be connected to a sump such as an oil pan in the case of a conventional combustion engine.

In known structures, the drain outlet is provided with a valve to prevent loss of oil during normal use of the filter assembly. Typically the valve is arranged in a machined bore and has numerous metal and/or plastic parts arranged to close the outlet using a ball bearing. Such a drain outlet valve is therefore difficult and expensive to manufacture. Furthermore, the location of the drain outlet valve at the bottom of the housing is disadvantageous as contaminants and sludge in the oil tend to collect and over time cause clogging or damage to the valve. It is physically difficult to clean or replace the valve given its location. The present invention is intended to improve the drain outlet arrangement.

According to the present invention, there is provided a fluid filter assembly comprising:

a housing having an fluid inlet and a fluid outlet; and

a filter element mounted on a support within the housing between the fluid inlet and the fluid outlet,

wherein the housing has a drain outlet closed by the filter element support and the fluid filter assembly further comprises a resilient loading element loading the support

against the drain outlet.

Accordingly, on removal of the filter element and the support, the drain outlet is opened and the residual oil in the housing is allowed to drain. As a result of using the filter element support to close the drain outlet, it is not necessary to provide a separate valve within the drain outlet. Therefore the cost and difficulty of manufacture of such a drain outlet valve are avoided. Similarly, the problems of such a drain outlet valve clogging or being damaged are avoided.

The resilient loading element loading the support against the drain outlet is effective to close the drain outlet tightly. This avoids the need to provide the filter element support with a tight fit within the housing which would create difficulties in manufacture given the small tolerances required and would introduce difficulties in insertion and removal of the filter element.

In addition, the resilient loading element can be used to load sealing faces of the support which seal the filter element between the fluid inlet and the fluid outlet. Therefore, the resilient loading element can be provided with the additional purpose of effecting a tight seal for the filter element as well as tightly closing the drain outlet and hence be given a dual-purpose.

~~Preferably, the loading element is a resilient loading element.~~

The present invention may be advantageously applied to a conventional type of filter assembly in which the housing comprises a base and a removable cap fitted together, the drain outlet being formed in the base. In such an assembly, the cap may be removed to allow replacement of the filter element. Conveniently the loading element is provided between the support and the cap.

Desirably, the support is retained on the removable cap. As a result, when the cap is removed, the filter element and support are also removed by virtue of being retained on the cap, which in turn causes opening of the drain outlet to allow draining of the fluid.

Advantageously, the support has a retaining portion protruding from the support and engaging the cap, and the loading element is a coiled spring, the coils of which encircle the retaining portion. This provides a compact structure for the loading element and retaining portion.

The present invention may advantageously be applied to a filter assembly employing a conventional filter element which is annular and has a support including an annular end wall extending around one end of filter element. In this case, the annular end wall may be used to close the drain outlet. Thus, the present invention may be applied using the annular end wall as a face to close the drain outlet, this being is a portion of the filter element support which would be present in any event, thereby avoiding the need to form the support with additional structural elements. The annular end wall is suitable for closing the drain outlet as it is typically flat in order to cover and to conform to the annular edge of the filter element.

Furthermore, the present invention may be applied where the annular end wall of the support has a resilient annular valve element which constitutes a non-return valve across the inlet. In this case, the resilient annular valve element may be used to seal the drain outlet. Thus, an element of the support which is already present for one purpose may be provided with the additional function of closing the drain outlet without the need to provide any additional structural elements. Furthermore, being resilient, typically made of rubber, the resilient annular valve element provides a good seal to the drain outlet by its very nature.

Where the annular valve element comprises a base portion disposed adjacent the annular end wall of the support and a resiliently flexible flap extending the base portion to close the fluid inlet and constitute the non-return valve, then preferably the base portion seals the drain outlet. This enhances the seal provided by the valve element, because the base portion is reinforced by the annular end wall of the support adjacent against which it is disposed.

Preferably, the valve element is retained on the annular end wall of the support. Accordingly, the seal is inevitably replaced together with the filter element. This is advantageous because the annular valve element is regularly replaced, before it degrades and allows leakage through the drain outlet.

Preferably, the fluid outlet is disposed adjacent the drain outlet and has a rim protruding into the housing beyond the drain outlet. This is advantageous because it allows the fluid to drain out though the drain outlet in preference to the fluid outlet, therefore preventing unfiltered fluid from leaking out of the fluid outlet.

A fluid filter assembly which embodies the present invention will now be described by way of non-limitative example with reference to the accompanying drawings in which:

Fig. 1 is a cross-sectional side view through the centre of the fluid filter assembly; and

Fig. 2 is a cross-sectional top view of the housing of the fluid filter assembly along line II-II of Fig. 1 with both the filter element and port being removed.

The fluid filter assembly comprises a filter element 1 disposed in a housing 2 formed by a base 3 and a cap 4. The base 3 comprises an end wall 5 and a generally cylindrical wall 6 upstanding from the end wall 5 and formed with an internal thread 7 at the end of the cylindrical wall 6 distal from the end wall 5.

The cap 4 comprises an end wall 8 and a generally cylindrical wall 9 extending therefrom with an external thread 8 at its distal end which screws into the internal thread 11 of the base 3 to releasably fit the cap 3 and base 4 to form the housing 2. Alternatively, instead of screw thread any means may be provided for releasably securing the cap 3 to the base 4, for example a bayonet fitting 4 or any other conventional means.

An O-ring seal 10 is disposed in an external groove in the cylindrical wall 9 of the cap 3 to seal against the cylindrical wall 6 of the base 3.

The base 3 and cap 4 may be formed of aluminium, another metal or preferably of a plastics material. The walls 5, 6, 8 and 9 of the housing 2 together define a cavity in which the filter element is disposed.

The filter element 1 is a corrugated sheet of any suitable material such as paper or a paper-like material, formed into an annulus. A first annular end wall 12 and a second annular end wall 13 are secured to respective axial ends of the filter element 1. The filter element 1 together with the end walls 12 and 13 have a tight push-fit over a generally cylindrical core 14 to abut an annular shoulder 15 formed around the core 14. Consequently, the core 14 and the annular end walls 12 and 13 together constitute a support for the filter element 1 which is disposed within the housing axially within the cylindrical walls 6 and 9. The core 14 is formed with a plurality of apertures 34 to allow the filtered fluid passing through the filter element

1 into the centre of the core 14.

The core 14 and hence the filter element 1 and the end walls 12 and 13 are retained on the cap by a plurality of axial projections 16 circumferentially spaced around the core 14, each with a radially outwardly extending lip 17 and together constituting a retaining portion . The cap 4 is formed with a plurality of projections 18 extending axially from the end wall 8 of the cap 4 and spaced circumferentially around the outside of the projections 16 of the core 14. The projections 18 of the cap 4 each have an inwardly extending lip 19 which radially overlap the lips 17 on the projections 16 of the core 14. Accordingly, engagement between the lips 17 and 19 retains the core 14 on the cap 4 when it is removed from the base 3 whilst allowing some relative axial movement between the core 14 and the cap 4.

As a result of the gaps between the two sets of projections 16 and 18, during manufacture it is easy to fit the core 14 to the cap 4 by forcing the core 14 onto the cap 4 and radially deflecting either or both sets of projections 16 and 18 to allow the lips 17 and 9 to pass.

Arranged within the core 14 at the end nearest the cap 4 is a conventional over-pressure valve constituted by a valve member 20 engaged by hooked arms 21 to a valve spring 22 held by an annular flange 23 projecting internally from the core 14.

A coiled spring 33 is disposed between the cap 4 and the core 14 with its coils encircling the projections 16 of the core 14. The spring 33 acts as a resilient loading element to bias the core 14 axially of the filter element 1 away from the cap 4 by engaging the shoulder 15 formed on the core 14. Although a spring is preferred, any resilient loading element may alternatively be used, for example a metal press. ~~Alternatively, a weight could be provided as a loading element to bias the core downwardly in use.~~

The end wall 5 of the base 3 is formed with a fluid outlet 24 disposed in the centre of the end wall 5 with its rim 25 projecting into the core 14 through the centre of the first annular end wall 12. A circular wall 26 is upstanding on the end wall 5 of the base 3 encircling the fluid outlet 24 of the base. A fluid inlet 27 extends through the end wall 5 of the base 3 outside the circular wall 26. The fluid inlet 27 is formed in this instance by three openings as show in Fig. 3, but any number of openings may

be provided.

A drain outlet 31 extends through the end wall 5 of the base 3 and opens into the housing 2 through a widened portion 32 of the circular wall 26. The drain outlet 31 is connected to a sump, such as the oil pan where the filter assembly is used in a combustion engine.

A resilient valve element 28 in the form of an annular ring made of rubber or any other suitable material is adjacent the first annular end wall 12. The valve element 28 is retained on the first annular end wall 12 by an overhanging annular lip 35 formed on the inner periphery of the annular end wall 12. The valve element 28 comprises a base portion 29 disposed adjacent the first annular end wall 12 and a resiliently flexible flap 30 extending from the base portion 29 at an angle. The base portion 29 of the valve element 28 abuts the circular wall 26 of the base portion 5, and widened portion 32 of the circular wall 26 across the drain outlet 31.

The spring 33 loads the first annular end wall 12 against the circular wall 26, so that the first end wall constitutes a sealing face between the fluid inlet 27 and the fluid outlet 24 with the base portion 29 of the valve member 28 acting as a sealing element therebetween. The spring 33 also loads the first annular end wall 12 against the widened portion 32 of the circular wall 26 so that the annular end wall 12 closes the drain outlet 31, with the base portion 29 of the valve element 28 acting as a sealing element for the drain outlet 31. Also, the spring 33 loads the shoulder 15 against the second annular end wall 13 which therefore acts as another sealing face between the fluid inlet 27 and the fluid outlet 24.

The flap 30 of the valve element 28 seals against the end wall 5 of the base 3 outside the fluid inlet 27 to close the fluid inlet 27. Pressure in the fluid inlet 27 causes the flap 30 to flex outwardly allowing fluid into the housing 2 so that the flap 30 constitutes a non-return valve.

When the cap 4 is removed from the base 3, the filter element 1 and its support are removed at the same time, because they are retained by the projection 16 and 18 is removed at the same time. The valve element 28 is also removed because it is retained by the annular lip 35. Such removal opens the drain outlet 31 and allows the oil within the housing to drain away. As a result of the rim 25 of the fluid outlet 24 protruding into the housing 2 further than the adjacent drain outlet 31, excess fluid

drains out of the drain outlet 31 without leaking into the fluid outlet 24.

Subsequently, on replacement of a new filter, the annular end wall 12 of the support of the new filter element 1 closes the drain outlet 31 and sealing thereof is provided by a new valve element 28.

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